2004 DNRC Sustained Yield Calculation Report
DNRC Responses to Questions from the Public, 11/8/2004

QUESTION	RESPONSE
1. There is a very large discrepancy between the biological potential (i.e. the highest sustainable harvest level possible) in the 1996 Sustained Yield Study and this draft 2004 study. In 1996 James Arney calculated the biological potential as 58.6 million board feet from 616,825 forested acres. Mason, Bruce and Girard calculated the biological potential as 94.6 million board feet from 726,662 forested acres. According to Brian Long at least 60,000 of the additional 109,837 acres in the draft 2004 study is in eastern Montana, between 30,000 and 50,000 acres are in western Montana. We do not understand how the biological potential can increase by approximately 61% when the acreage increase was only ~18%; and most of this is in eastern Montana where sites are not as productive.	1. There are four major reasons for the difference: • Constraint differences between Schedule A (1996) and BM001 (2004) runs • Additional forested acres • Updated inventory • Different harvest schedule models The 1996 Schedule A run, which calculated the 58.6 MMbf sustainable biological harvest level, reflects several constraints that were not applied to the BM001 run in the 2004 calculation. In the 1996 study, the coarse filter, snag and snag recruit retention, and minimum harvest flow constraints were all included in the calculation of the biological potential which reduce the potential biological yield. The 2004 study only included the minimum harvest flow constraint which was less than the minimum harvest flow constraint used in the 1996 study. The second factor contributing to the difference between the two biological potentials is the additional acres included in the 2004 study. An additional 109,837 forested acres were added to the inventory since the 1996 study. More acres means more land growing trees which equates to a higher sustainable yield. In addition to more acres, the Stand Level Inventory (SLI) was updated since 1996. New or updated SLI data was collected for approximately 346,000 acres in the Northwest and Southwest Land Offices since the last study in 1996. This was done to reflect changes due to fires, salvage harvesting, timber sales, planting, etc.

	While both studies used similar growth models, the harvest scheduling models were different. The 2004 study used a linear programming (LP) model that looks across time (175 years) and space to find the best set of forest management strategies, given the objectives and constraints facing DNRC land managers. This modeling effort was meant to maximize sustainable revenue as present net value (PNV) while maintaining a healthy and diverse forest by selecting the best long-term management strategy from among a great many options or regimes. The 1996 harvest scheduling model does not include a maximization routine. It simply provides a biological harvest level predicated on the objectives and constraints given the model. In other words, the 1996 model was told to apply a specific regime to a specific stand type. The yields determined for the 1996 study were all based on limited treatment options with no ability to preferentially select a higher yielding regime instead of a lower yielding regime. The 1996 approach only provides the predicted yield given the constraints and management regimes provided to the model – not what the biological potential really is. Since the LP model had the ability to make choices in attempting to maximize sustainable revenue (PNV) under a non-declining yield constraint, it consistently chose even-aged management regimes over uneven-aged management regimes in the early runs. This was due to the fact that uneven-aged regimes were less productive than even-aged regimes. This will be discussed in greater detail in question 3.
2. We realize that two different models were used, but a 36 million board foot (mmbf) increase in maximum harvest levels between the two studies deserves	2. The 94.6 MMbf/year estimated in the current study included all acres and no constraints, except that the harvest had to generate a minimum of 1 Mbf/acre. The

explanation. If harvestable criteria were changed between the two studies then DNRC should provide an explanation of why they are different. What changed on the ground to warrant these changes in assumptions?	58.6 MMbf/year estimated as the biological potential yield from 1996 included deductions for several constraints not contained in the current estimate of biological yield. These constraints included reductions for snag and snag recruits, minimum harvest volume levels, and coarse filter factors. Nothing changed on the ground. The harvest criteria changed due to a review by DNRC field foresters of the 1996 minimum volume needed to make harvests economic.
3. Can we expect the next sustained yield study to use different criteria again? Where is the consistency between these reports?	3. Both sustained yield calculations were consistent in that DNRC modeled restrictions on management of state forest lands to reflect constraints and mitigations for wildlife and old growth based on policies and laws in effect at the time. While the 1996 study relied on the SFLMP, the current study incorporated the SFLMP management philosophy and the Forest Management Rules. The Forest Management Rules clarified and codified the direction from the SFLMP. A few criteria for the current study were different than the criteria used in the 1996 study (minimum per acre harvest criteria was reduced). Other differences reflected formatting or input needs of the two modeling efforts rather than actual changes in criteria or policy. A policy that has changed since the 1996 study – the DNRC no longer has a numeric old growth retention commitment as a result of a new law, 77-5-116 MCA. However, the department modeled specific treatments designed to maintain the old growth designation post-treatment.
4. How can the public and the Land Board possibly make informed decisions when DNRC changes the criteria and models from study to study?	4. Models and modeling efforts have improved over time as new software and new hardware have become available. DNRC anticipates using the best tools available in the future even though they

	may be different than what were used for this calculation or the 1996 calculation. The criteria used to model sustained yield will change to reflect changes in law or the rules. DNRC recognizes the concern over using different models to predict a sustainable yield. However, in this situation the growth models used in each study share a common heritage. The 1996 study used an amended and updated version of the Stand Projection System model originally developed by Dr. J. Arney. The current study also used an amended and updated version of the Stand Projection System. The harvest scheduling part of the two models was different.
5. Before the Land Board and DNRC adopts 53.2 mmbf as the target amount of timber to be logged from state lands there must be an effort to validate the model. DNRC has not done the spatial mapping to see whether logging this amount is feasible. For example, how does DNRC know if all inaccessible stands were identified if there wasn't data for all the stands? Mason, Bruce and Girard caution throughout the document that the sustainable yield calculation is an estimate and the model has limited spatial capabilities. (p. 5) We urge DNRC to validate the model to see if the increase in logging is feasible prior to adopting 53.2 mmbf as your timber target.	5. Various components of the Forest Management Model were validated during development by comparing known yields and field data to model results. For example, the individual yield tables went through numerous iterations designed to make the growth and yield model accurately estimate future forest characteristics. Field foresters, with specific knowledge of local conditions, at each Unit office, made the determination of whether or not a parcel was accessible. Data and forest polygon maps were available for all forested stands. In addition, a sensitivity test was performed on run SYC008 to test the spatial robustness of the solution. Fifty percent of the acres scheduled for harvest in the first ten years were made unavailable to the model for those first ten years. These constraints were imposed analysis unit by analysis unit and covered nearly 45,000 acres. Rerunning the model with this new set of constraints dropped the harvest level

	only 1.5%. This indicates DNRC foresters will have a great deal of flexibility in deciding which acres to harvest.
6. Lands included in the model's timber base are being considered for other uses such as residential and commercial development. For example, lands around Whitefish (approximately ~13,000 acres) that are currently considered timberlands are in the process of being converted to other uses. DNRC has identified other acres around the state for possible development too (see the DEIS for the Real Estate Management Plan). DNRC's attitude seems to be that in 10 years the sustained yield will be recalculated so you will catch up to these land conversions then. We do not believe this is prudent trust management, especially when you know now that certain lands will be removed from the timber base. In essence, by not removing some of these lands from the sustained yield calculation you are skewing the sustained yield calculation upwards and will wind up having to log more timber off a shrinking land base until the next study catches up with it. The process will then be repeated again when the next study is done. In addition to the effects on sustainability, this has impacts on wildlife habitat, water quality, fish, old-growth forests, big game, hunting and fishing opportunities and other recreation.	6. DNRC can not assume all or any part of the forest land in the Whitefish area will no longer be managed for timber production until a decision has been made regarding these lands. An attempt to anticipate a certain decision or outcome would be inappropriate. By law, the sustained yield must be recalculated every ten years. If there are circumstances that cause significant reductions in the manageable forest acres or significant changes in forest characteristics, DNRC, the legislature or the Land Board can choose to recalculate the sustained yield sooner.
7. The report does not give an inventory of the Forest by Management Units. It uses a 1980's Forest Service inventory that contained different standards and is not suitable for management. Also, the report does not disclose what the yield in MBF's has been, what the unit price paid and dollar paid are and what DNRC's costs to generate them are.	7. The inventory in the model was reviewed both in total and by geographical subdivisions within the model. The final report will contain an appendix displaying beginning inventory data used to start the modeling process. The beginning inventory used to build the model is based on USFS FIA data collected in 1988 and 1989. It is the most comprehensive data currently available.

	The prices and costs used in the analysis are discussed in section 3.1.5 of the report. Prices are shown by species and land office. Costs are broken into fixed and variable costs by land office.
8. The report does not disclose the volume, species, stand structure, age classes, fire history, stand condition, road, access conditions and the other relevant factors. What is the current forest condition, acres burned per decade, insect and disease levels? Stand conditions are only estimated. The report discounts the effects of disease, fire and insects as being episodic, so they are not included in the long range growth calculations upon which the sustained yield assumptions are based. There is an increasing body of evidence indicating that insect infestation, particularly bark beetles, may no longer be episodic but chronic, presumably because of global warming. If this is the case, growth calculations should be reduced, thus the sustained yield calculation too. Fire should also be considered a chronic event and factored into the calculation. Most of western Montana's forest land is re-growth from the 1910 fires, and the trees have reached the size and age for insects, fire, and harvest. Figures based on current acreage burned are likely to be too low if projected very far into the future, since new stands, e.g. <25 years, are generally more flammable than old stands due to logging slash residue and a higher percentage of fine (small) fuels - twigs instead of large trunks. So perhaps the growth models should have included discounts for both fire and insects in addition to grizzly bears and riparian areas.	8. The report discloses volume for each model run. Each model run incorporates species, stand structure, age, stand condition, fire history (as exemplified by stand conditions), and other relevant factors in the calculation of sustained yield. All known current conditions were incorporated through the use of the stand level inventory (SLI). The effects of fire and insect epidemics are not modeled explicitly. However, all growth models have mortality functions designed to represent the on-going endemic levels of various causes of mortality. Catastrophic occurrences are beyond the scope of this project and very difficult to predict and so were not incorporated. Catastrophic fire or insect attack would trigger salvage harvesting which would be included as part of the annual sustained yield harvest. As an example, the thousands of acres burned in the Sula State Forest had very little impact on our sustainable yield because much of the dead volume was harvested and substituted for otherwise green harvests, which were consequently delayed for future harvest. Before the fact reductions will contribute to future losses by not maintaining a healthy forest. If DNRC speculatively reduced harvest levels because of the potential for future mortality the DNRC would be contributing to an increased risk of future loss. Harvesting at the appropriate time will reduce susceptibility to fire, insect and disease problems while capturing a higher value product than would occur if we deferred harvest and waited for the stands to die or burn. The DNRC's fiduciary

	responsibility to the trust beneficiaries requires the DNRC to maintain the forest in a healthy condition. The proposed 53.2 million board feet harvest level is a conservative harvest rate. DNRC has an excess amount of existing board foot volume necessary to maintain an annual harvest of 53.2 million board feet. The model indicates DNRC can harvest 58 million board feet per year for 60 years and still maintain a sustainable harvest rate of 53.2 million board feet per year. This provides a significant level of assurance that 53.2 million board feet is sustainable over the long term and is certainly sustainable until the next calculation even if DNRC does experience increased fire and insect mortality. The next sustained yield calculation will occur in 10 years by law or sooner if DNRC is directed to do so.
9. What is the minimum harvest age used? Does the model project growth from diameter at breast height like the 1996 model did? If so, how many years does it take for a tree to reach breast height? Factors that may affect this are slope, aspect, elevation and precipitation. Was that factored into the minimum harvest age?	9. The minimum harvest age was 70 years. The architecture of the growth model used in 1996 is the same as that used in this study (both are modified versions of the same base model). Tree growth is a function of size, species, stocking, distribution and site quality. Time to breast height varied by species, stocking, potential vegetation, and residual stand density. The approach used in 1996 formed the basis for determining young stand growth in the current model. The current model requires trees to be of sufficient size for the model to grow them accurately. Using the information available in the SLI and from the 1996 study, regenerated stands were provided to the model that varied in trees per acre, distribution, species composition, size, and age depending on site factors, such as

	location, site quality, and potential vegetation, as well as to reflect treatment differences.
10. Are negatively valued lands scheduled for harvest? If so, where in the planning cycle? How will this affect long-term timber projections?	10. The Forest Management Model was not designed to calculate the economics of management on a sale-specific basis. However, all timber sales are designed to be economically viable. Early model runs, however, indicate that all manageable acres have management regimes that contribute positively to the present net value. Management constraints were designed so that partial harvest entries harvest enough volume to make the entry economically viable.
11. What is the margin for error in this linear programming model? Has the sustained yield calculation been adjusted to consider this?	11. The linear programming model is not a statistical model – the concept of "margin of error" is not an appropriate concept for that model. The linear programming model does make use of inventory data collected by sampling. Sampling error could be computed for the beginning inventory, but was not. Given the way we used the FIA inventory data, we would expect the total inventory to be close to the inventory statistics associated with the FIA inventory. More important than the beginning inventory data are the projections about how that inventory will change in the future as a result of management. The SPS growth and yield model does not provide any statistical "margin of error" for the future projections. And, we are unaware of any growth and yield model that does. In general, we are more confident about the near term projections than the long term projections, and more confident in the projections for managed stands than those for unmanaged stands, as discussed in the

	report. More important than the precision of the growth and yield estimate is the question as to whether the estimates are biased. The growth estimates agree favorably with estimates in past planning efforts and estimates based on FIA inventory reports. We do not have any reason to believe that the growth and yield estimates are overstating future growth.
12. How did DNRC determine that the productivity of even-aged stands exceeds mixed aged stands?	12. The DNRC did not determine this difference. This difference was demonstrated through the modeling results. Early model runs (BM001) were relatively unconstrained which allowed the model to select the management regime that would maximize the sustained revenue under the non-declining yield constraint. These early model runs consistently chose even-aged management regimes over uneven-aged management regimes. Average productivity in these early runs was about 142 bf/acre/year. Later runs forced acres to the uneven-aged management regimes. In these later runs, the average productivity dropped to 119-123 bf/ac/year along with an associated drop in harvest levels and PNV. In general, the uneven-aged regimes are less productive and more costly to implement and, therefore, less profitable than the even-aged regimes. Under highly controlled (research) conditions, one might expect the yields to be similar between the two management regimes. However, growth and yields for uneven-aged forests are typically less under large-scale forest management operations due to several factors such as timing issues with achieving desired regeneration, pre-commercial thinnings and selection harvests, meeting residual stocking targets after each entry on a site-specific basis (too low verses too high), species specific needs, and other operational and

	environmental reasons.
13. How were unsuitable and lower productivity timberlands such as lands with past regeneration failures or slow growth rates factored into the model?	13. Unsuitable lands (non-commercial) were removed from the calculation. Low productivity lands (slow growth) were modeled as such, with a lower site index. Non-stocked lands were given a delayed regeneration period.
14. Riparian area constraints are not consistent with the SFLMP Administrative Rules. Modeled riparian buffer widths were 50 feet if fish were absent and ranged between 80 and 120 feet if fish were present. It is unclear what buffer widths were put into the model for sensitive watersheds but sensitive waters do not appear to include high erosion risk sites. ARM 36.11.425(1) The department shall establish a riparian management zone (RMZ) adjacent to the minimum width of the SMZ required under ARM 36.11.302 when forest management activities are proposed on sites with high erosion risk or on sites that are adjacent to fish bearing streams or lakes. ARM 36.11.425(3) When the department proposes forest management activities on sites determined to have high erosion risk: (a) the department shall establish an RMZ with a minimum of 100 feet when activities are located on slopes greater than 25% but less than 35%; (b) the department shall establish an RMZ with a minimum of 150 feet when activities are located on slopes greater or equal to 35% but less than 50%; (c) the department shall establish an RMZ with a minimum of 200 feet when forest management activities are located on slopes greater than or equal to 50%. How many riparian acres are in high erosion risk? Why are the fish bearing buffers in the model less than those listed above?	14. The riparian management buffers utilized in the SYS are consistent with the SFLMP Administrative Rules. Under ARM 36.11.425, activities restricted within an RMZ established for high erosion risk are limited to road construction, ground-based equipment operations and cable yarding systems. Harvest prescriptions within an RMZ established solely for high erosion risk are not restricted beyond the minimum retention tree requirements under the Montana SMZ Law and Rules. Under the SMZ Law and Rules when an SMZ is greater than 50 feet (slopes > 35%) retention trees are required to be concentrated in the first 50 feet. This requirement is reflected in the silvicultural prescriptions developed for fish absent RMZs. Under ARM 36.11.425, only timber harvests conducted adjacent to fish-bearing streams are specifically required to retain adequate shade and potential large woody material that may go beyond the minimum retention tree requirements under the SMZ Law and Rules. In these cases, the streamside harvest prescriptions are applied to an RMZ width based on site potential tree height for tree age of 100 years. The 80-120' RMZ widths utilized in the SYS reflect regionalized average potential tree heights based on DNRC field plots. We did not calculate riparian acres in high erosion risk areas because high erosion risk alone does not affect harvest prescriptions beyond the minimum retention tree requirements under the SMZ Law.

15. The definition of sustained yield is incomplete. The 2004 SYS says only "the yield a forest can produce continuously under a given intensity of management". No mention is made about abiding by laws that protect fish, wildlife, recreation, or about maintaining watersheds, water quality standards, fisheries, and aquatic life: All things that were included in the definition of sustained yield in the 1996 study. The SFLMP and applicable laws have not changed and neither should the focus of management.	15. See Appendix H for the complete sustained yield law. The SAF definition was included to clarify the definition from statute, not to suggest the department would ignore its legal requirements to meet the law. Inclusion of the SAF definition does not affect the calculation.
16. Information on the acres included in the SYS lacks sufficient explanation. Page 2 says that The DNRC manages 726,700 acres of forest land. Page 4 it says that 284,000 acres of forest land for Central, southern, Eastern and Northeastern Land offices have been added to the inventory. This is a huge number of acres to suddenly "discover", yet no explanation is given for where these acres came from and why DNRC did not know enough about them to include them in previous studies. It also raises many questions about DNRC's inventory procedures. Have these acres been field verified? Where exactly are they located? Although page 4 states that 284,000 additional acres were included, it turns out the difference between the 1996 and 2004 studies, after taking acres away for reserves, old growth, etc, is really only 67,015 acres. (363,769 acres in 1996 and 430,784 acres in 2004). Besides the fact that this information is nowhere clearly displayed, there is no explanation about these acres. How many of the 67,015 acres are from the recently discovered acres and how many are due to differences in the model, the administrative rules, etc.?	16. DNRC stand mapped 284,000 acres of forest land in the Central and Eastern Land Offices and added them to the stand level inventory after the 1996 study. The forest land acreage estimate used in the 1996 study was based on a USFS statewide inventory conducted in 1988/89. The USFS inventory estimated the forest land in those same Land Offices to be 180,000 acres. The new inventory data was the result of a more thorough inventory process concentrating on DNRC owned parcels and utilized newer aerial photos. Page 31 of the draft SYC report displays the reduction in managed acres occurring in each subsequent model run. Nearly all of the 67,000 acre difference in managed acres between the two sustained yield studies occurs in the Central and the Eastern Land Offices. Nearly all of this increase in manageable acres was due to the new inventory data. The new inventory data was reviewed by DNRC foresters working in each Land Office.

17. The Maximum Biological Potential calculated by this model is far higher than the 1996 model and adequate explanation is not given. The 1996 SYS model calculated a maximum biological potential of 58,579 MMBF on 616,825 acres (page 34 of 1996 study, table 21, Schedule A - Sustained Yield from all forested acres, no reserves). The 2004 model calculated a Maximum Biological potential of 94.6 MMBF on 668,168 acres (page 23 of 2004 SYS). That's a difference of almost 1.5 times higher yield per acre in the 2004 study. That points out that there are huge differences between the models used in the two studies, but no explanation is given. To simply say that "the models are different" says absolutely nothing. A model is a tool, nothing more. It is subject to the same human fallacies as any endeavor, and more than most. Models are particularly dangerous because since so few people really understand what is going on once the data goes into it, few people have the guts and confidence to admit they don't understand the model and to question it's results. It is the modelers responsibility to explain, in lay-person terms the assumptions and limitations of the model. When a model produces a result that is so vastly different from the previous model, a thorough explanation is required. This explanation must be intelligible to all members of the land board as well as the general interested public.	17. See response to similar questions 1 and 2 above. The DNRC acknowledges the commenters concern that few people understand the intricacies of modeling. To accommodate those concerns the department has avoided an overly technical presentation that might confuse the reader.
18. Page 8 states that forest land that burned in the summer of 2003 was not reclassified for this project. How much land burned? Was it mature timber? This should be explained.	18. DNRC estimates there were approximately 5,400 acres of forest land burned in 2003. Not all of these acres were mature timber and not all of these acres experienced a stand replacement fire. On many acres, there are many live trees within the fire boundaries. DNRC intends

	to update the stand level inventory to reflect the change in forest composition due to these fires as soon as suitable aerial photography is available for these burned areas. Any effects on sustained yield caused by these fires will be exhibited in the next sustained yield calculation. Fire and other causes of mortality have a very minor effect on the sustainable yield because DNRC salvage logs the majority of the burned or dead timber. DNRC uses the salvage volume to replace green tree volume to achieve annual board foot volume targets.
19. Page 8 says that the model moves the stands towards the "desired future condition". More information should be given on what the desired future condition is for state lands, and what it is based on.	19. The desired future condition for state lands "can be characterized by the proportion and distribution of forest types and structures historically present on the landscape". It can be stated as an increased representation of shade intolerant tree species throughout our ownership. As such, treatments that increase the proportion of shade intolerant tree species move us in the direction of desired future conditions. We did not model a more complicated and restrictive ecosystem diversity matrix for this project. The department's DFC for cover type representation has been public knowledge and is available on request.
20. How do the riparian buffers used in the model compare to recommendations made by FW&P, the DNRC rules, and federal guidelines for T&E species? It appears the model ignored the wider SMZ widths in the administrative rules for sites with high erosion risk. What other rules and laws did the model completely ignore?	20. Refer to answer provided to similar question 14.
21. Page 11 talks about estimated stand conditions for younger stands. There are a fair number of stands that have not regenerated as hoped for or expected. Was	21. All relevant conditions of the forest managed by the DNRC were considered in the calculation. Assumptions about future regeneration success are based on current

this considered in the model? Most state lands are only on their first or second rotation. How is it possible to reliably predict the regeneration of young stands in the future, especially after 3, 4 or 5 rotations when we can't even predict regeneration after one rotation? In an unnatural scenario, where most organic matter is removed and soils are not replenished as they would be in an un-managed forest, how can you possibly hope to predict regeneration?	results with no allowances made for future progress in genetic growth potential, better seedling stock types, better site preparation tools, and other advances. Future regeneration success is best represented by the most current results, not by the success demonstrated ten, twenty or more years in the past. The condition described by the commenter was not modeled because it does not represent either current or desired DNRC practices.
22. Page 13 shows the productivity class (low, medium and high) for stands in the Eastside, SWLO and NWLO. This shows clearly that stands in the eastside are far less productive than stands in the SWLO, and to an even greater degree in the NWLO. This raises even more concern about the Maximum Biological Potential calculated by this model as compared to the 1996 model, because most of the additional acres in the 2004 model are in the Eastside, with by far the lowest productivity. There is no mention or explanation of this fact in the 2004 SYS.	22. The productivity situation is stated in the report. All model runs utilized site specific potential productivity data provided by the SLI that was then placed into high, medium, and low classes that varied by Land Office. All the yield tables were developed using the class-level potential productivity data. This is explained on pages 13 and 16. The acreage by site class is displayed in Appendix C.
23. Page 14 states "The yield projections reflect improved growth from stocking control and proper tending of young seedlings". Improved over what? Current conditions? This statement needs explanation. Does this mean that the model is assuming that growth of seedlings will improve over present growth? Does the model assume seedlings will receive better care than they are now? Is meeting these assumptions a necessary prerequisite for achieving the projected timber yields? How in the world are the foresters going to be able to control stocking and give more care to the young seedlings, if they are also supposed to harvest over 11 MMBF more	23. DNRC agrees this statement would have been more effectively presented in the results section. The statement refers to the fact that stocking control (e.g., stands not over nor under stocked) provides significant growth benefits versus stands that are over or under stocked. The proper tending of young seedlings refers to the need to conduct pre-commercial thinning at an early age to prevent stagnation and significant loss of growth and structural stability. Workload issues are beyond the scope of this project. The department will determine if additional funding or

than are currently? This is totally unrealistic. It is also unfair to the DNRC foresters. Does DNRC management believe the foresters are intentionally ignoring seedlings and stocking recommendations, and that they will do a better job simply because this is what the model requires?	personnel are required to meet the new sustained yield harvest level. If additional resources are needed they will be secured through the appropriate channels. The model does indicate that some treatments produce greater yields than do other treatments and DNRC would not meet fiduciary obligations to the Trustees if we ignored them. However, model predictions of planting and thinning are similar to the amounts being conducted currently.
24. Page 15 makes the statement: 'We assume that the SLI accurately portrays the status of each timber stand. Unit foresters for example, identified stands that could not be harvested because of operability and access issues. We assume that all stands not so designated are indeed available for harvest." This is not a safe assumption given the fact that the DNRC didn't even apparently know enough about the existence or condition of 284,000 acres of land to include them in the 1996 study. Are they assuming that all of the recently discovered acres that were actually included in the SYS are available for harvest? Have they been field verified? This is an overly optimistic and unsafe assumption.	24. All department analyses are based on the best available data and information. Given no one has better knowledge of the forests we manage than our own foresters we believe it is the only safe assumption that can be made. However, the department always welcomes objective and verifiable research or quantifications that improve its knowledge of the lands it manages. The current sustained yield calculation is based on new inventory information collected since the 1996 study was completed. An additional 24,000 forested acres were found in Central Land Office and an additional 80,000 acres of forest land were found in the Eastern Land Offices. Forest land in NWLO and SWLO increased by 6,000 acres. There were no stand maps for our foresters to review for the 1996 study. DNRC utilized the best information available in 1995 which was tabular data from the USFS. There were 270 polygons in Central and Northeastern Land Offices field checked and compared to the new inventory database. Only 4 polygons out of 270 were found to be brush with scattered trees (non-forest land) an accuracy rate of 98.5%.
25. Page 15 discusses some limitations of the model. It states "But for any given set	25. Spatial considerations are not ignored by the model. Only stands determined to

of characteristics, the model is unaware of how many polygons contribute to the total acres or the spatial juxtaposition of the polygons. As a result, we are careful not to disaggregate the model solution to the stand level, nor to ask questions that presume more spatial detail than we have". This is a serious limitation that renders the model results highly suspect as implement able. Spatial considerations are very important, and often a critical consideration in timber sale design. It doesn't matter how much timber is available in a stand if it cannot be harvested in an economically and logistically feasible manner. There may be many stands that are not identified as technically inaccessible by the foresters, but for a variety of reasons are not feasible to harvest, or to harvest as intensely as the model would predict. What about social considerations and issues identified by the public through scoping? What about unique habitat elements that are only discovered during timber sale preparation? This will severely limit the foresters ability to manage the land as it is really appropriate. Ignoring spatial considerations, and assuming that all acres can be harvested in an optimum fashion, is naive to real world considerations.	be accessible and manageable were included in the calculation. Unique habitat elements are very rare and have, to date, had negligible impact on our accomplishing our mandated yield; if identified they were removed from the timber base. The sustained yield law prevents the department from making social decisions given the requirement to abide by, but not exceed, applicable laws and regulations. The question comes down to doing what we said we would do, as is displayed in the current study, or doing something other than what we said we would do. The department can only meet its SFLMP objectives by implementing the intent of the SFLMP. The level of spatial specificity from the model is important. There are over 5,500 unique analysis units distributed across the landscape and stratified by location, proximity to streams, association with roads, by unit office, by sensitive watersheds, etc. The key statement is the caution that we do not ask the model "questions that presume more spatial detail than we have.", which we have avoided doing.
26. The model does not take into account the effects of insects, disease and fire. Page 34-35 states "...while the growth and yield model projections account for competition induced mortality, they do not project episodic mortality from insects, disease, or fire." These agents of change may take many acres out of the harvest-able timber base yet the model doesn't even take it into account. After decades of fire suppression there is a huge backlog of acres that are ready to burn, some of which surely will before they can be harvested. It would have been a fairly simply matter,	26. See response to question #8.

and added a much needed dose of reality to this model, to take a ten-year (for example) average of acres burned in Montana, express that as a percentage of total forest area over which burned areas area measured, and apply that percentage to state lands as acreage lost. Insect infestations and diseases can wipe out huge areas, as has happened in British Columbia with the mountain pine beetle epidemic. A June 10, 2004 news release from the B.C. ministry of forests states "While mountain pine beetle epidemics are natural events in B.C. the recent outbreak is unprecedented in the province's recorded history. The first phase of new ongoing research completed by the ministry and the Canadian Forest Service concludes that the current infestation may peak in 2008, and under current conditions has the potential to kill more than 80 percent of the merchantable pine in B.C.'s interior." Global warming is cited as one of the main causes for the beetle epidemic, a phenomenon that Montana also. And yet the SYS completely ignored the potential loss from insects!	
27. Old Growth: Page 26 says that 80,900 acres of the 726,700 acres of forest land are identified as old growth using the Green et al., guidelines, which is 11.13%. The model is constrained to manage at least 75% of the dry and moist types currently identified as old growth under the old growth compatible uneven-aged management regimes. The remaining 25% can be harvested using any regime. Meaning that after 100 years, it may go down to 8.25% old growth. This is apparently a totally arbitrary number. No explanation is given as to how the number was derived, how it relates to natural historical conditions, how it will maintain	27. The Sustained Yield calculation should not be confused with a MEPA analysis that is designed to display effects. The required MEPA analysis is contained in the SFLMP. However, 77-5-116 MCA has required the removal of the numeric old growth retention requirement of the department. Old-growth set-asides appear to be contrary to the law. The old growth strategy displayed is one of managed old growth. Thus, while the department displays acres that meet the old growth definition there is no requirement for its retention in an un-entered condition. The department believes managing old growth is compatible with 77-5-116 MCA while deferring old growth

the ecological health of the forest, or how it complies with the administrative rules and SFLMP. There are 2 sets of old growth management regimes for old growth , one is based on a 30 year entry cycle and leaves the minimum number of large trees. The other set enter the stand on a 50 year cycle and leaves more large trees per acre than required to meet the Green et al., definitions. So 75% of the moist and dry stands will be entered on either a 30 or 50 year cycle. There is no mention or discussion of what proportion of stands will be entered on the 30 and 50 year cycles. This is important information that should be included to evaluate impacts. But it is clear that all stands are scheduled to be entered with some type of harvest. There is no provision for some stands to be managed on a long-rotation. This will not maintain stands in a condition that will maintain a semblance of natural conditions. There are also no old growth specific regimes for stands currently identified as old growth in the cool types because of the stand replacing nature of disturbance at these sites. There isn't even a discussion of how these stands will be managed, which should be included.	from harvest or setting it aside does not comply with the law. The stands described as being in the cool types have no corresponding old growth maintenance or restoration regime because the department believes those to be generally inappropriate with old growth that is in the stand replacement disturbance regimes. In other words, the dry and moist types are characterized by disturbances of less than stand replacement severity. Some intermediate treatments are appropriate and perhaps even required for old growth to develop. Stands that develop after stand replacement disturbance and progress on to become old growth do not have that frequent disturbance component and so there are fewer compelling reasons for frequent entry. The department has stated that 50% of the old growth on the cool types is available for harvest in the first 100 years.
28. Page 24 says that the snag and snag recruit retention policy is modeled by reducing total harvest volume by 1.5 Mbf/acre on moist types and 0.5 Mbf/acre on the dry types. How many trees/acre is this? How does this compare with historic conditions and the rules?	28. This meets the rules for snag and snag recruit retention. The rules were based on quantifications of historic levels.
29. Page 27 states that the desired future condition (DFC) described in the SFLMP focuses on moving the forest toward earlier seral stages. Where in the SFLMP is this	29. DFC's are referred to throughout the SFLMP and specifically in the SFLMP ROD p. 12. While specifically stated as a movement toward conditions that can be

stated?	characterized by those historically present on the landscape, it is well-known to ecologists and foresters that historical forests had higher proportions of early seral tree species. The comment from the report refers to "earlier seral stages" in relation to the dominant tree species present wherein shade intolerant species are called early seral. One should not confuse the term "earlier seral stages" with the recent use of the term "late-seral" as a surrogate for stand age where stands dominated by early seral species are sometimes referred to as late seral stands (such as old growth ponderosa pine stands on Douglas-fir habitat types).
30. Page 28 states "the 1996 SFLMP (Appendices, page SCN-20, Table T-2) specifies that 40% of the forest would be managed under even-aged systems. But this is only a small part of the SFLMP direction regarding silvicultural systems. For example, the discussion in the SFLMP (page SCN-19) preceding the table referenced states "Omega: The choice of silvicultural treatments would be based on the landscape level condition defined in the Biodiversity RMS, as well as site specific decisions based on site attributes, stand conditions, and treatment objectives". The SFLMP also makes a general statement regarding harvest levels under the Omega alternative (SCN-12): "We anticipate that higher levels of protection for old growth, fisheries and riparian zone quality, and wildlife species, may put downward pressure on harvest levels. For purposes of analysis, we estimate a range of sustainable harvest levels from a low of 30 MMBF to a high of 50 MMBF." From this, it appears that the SFLMP would consider anything over 50 MMF unsustainable. This inconsistency, and selective reference to the SFLMP, is not acceptable.	30. The percentages displayed in the SFLMP already incorporated the effects referred to by the commenter. Thus, the 40% even aged treatment estimate represented the proportion of harvests that would be even-aged when Omega was implemented. Some other amount was not intended. The SFLMP analyzed for a sustained yield of between 5 and 55 MMbf. New data and a more sophisticated modeling technique were utilized to calculate the current sustained yield than was used to make sustained yield estimates in the SFLMP. The entire current modeling effort was designed to calculate a sustainable harvest level while employing constraints and mitigations described in the Omega alternative in the SFLMP and the Forest Management Rules.

31. Page 28 Implementation Constraints: The constraints added to ensure that the harvest schedule could be reasonably implemented do not seem nearly enough. The first constraint is that the first five periods are limited to 11,000 acres per year, which approximates the maximum acres prepared for sale in any year since 1996. I asked DNRC for info on the acres prepared for sale in past years, and they sent me a data sheet on each sale in 2003 and 2004. I had to then add up the acres for each year. Following is what I calculated: Year # sales Acres Volume 2003 21 8,450 43,041 2004 25 8,773 50,800 Even 2004, which had the highest volume in any year listed (table page 3), only harvested on 8,773 acres. Putting a limit of 11,000 acres seems to do almost nothing towards making it implement able, since the highest volume ever to date was on far fewer acres than their "constraint". This brings up the whole issue of whether the DNRC can implement this volume target. A jump to 53.2 MMBF per year, on a continuous basis does not seem possible. Have the foresters been consulted on this new SYS? Do they think it's possible to practice good forestry at this level of harvest?	31. The department conducted this effort with major involvement of field foresters, wildlife biologist and hydrologist. The harvest level of 53.2 MMbf/year is biologically sustainable and has incorporated all requirements of the department. 11,000 acres represents approximately the highest level for any one year sold since SFLMP adoption. The average amount of acres treated in the first six periods for run SYC008 is about 7,900 acres. The average amount of acres treated through the entire 175 year projection for SYC008 is about 6,500 acres. These amounts of treated acres are well within the range of recent historical amounts of acres treated annually by DNRC.
32. Page 29 states: "This is not an appropriate model for examining certain kinds of management standards and guidelines, however. Seasonal use restrictions, road construction standards, snag management standards, sale design parameters, etc. are examples of management guidelines that do not lend	32. These issues do not affect long-term sustainable harvest levels and are handled at the project level. However, the costs associated with these management considerations are incorporated into the model parameters. The costs associated with seasonal use, road limitations, or other sale design constraints have very limited

themselves to this kind of modeling. For this reason, there are some provisions of the 2003 administrative rules that are not considered in this report." Whether or not the model can deal with those things, the foresters are sure going to have to deal with them. It is totally unrealistic and irresponsible to disregard real live issues and impose such a high timber target on state forests and state foresters, based on a computer model with as many problems as this one.	impact on DNRC costs. These costs were developed from historical agency wide information which includes the additional costs the agency has incurred as a result of these restrictions. The bulk of the costs from these kinds of restrictions are born by the timber purchasers who internalize these costs by reducing the price they are willing to pay DNRC for its timber. In addition, the sustained yield calculation accounts for road-related limitations by deferring from management forest lands that would not physically allow roads to be built and where DNRC did not have access.
33. Page 30 gives management advice. For example it says "Pre-commercial thinning is a major activity required to achieve the yields calculated by the model". Where are the foresters going to find time to write up and administer these contracts? Are there other major activities that are required in order to make this timber target achieve-able?	33. Workload issues are beyond the scope of this project which is to calculate an annual sustainable yield. However, amounts of pre-commercial thinning and planting predicted by the model are very similar to current operations. Allocation of the harvest level and workload issues will be addressed with the area offices.
34. Page 30 states "To the extent possible, the model assigns the more productive acres to even-aged management regimes". More productive areas are also more valuable for wildlife, biodiversity and old-growth habitat. More productive sites grow bigger trees which are an essential habitat component for many species of wildlife. This bias towards assigning more productive areas to even-aged regimes will have serious consequences for wildlife, biodiversity, and old-growth. It is counter to maintaining the range of natural historic conditions across the landscape as directed by the SFLMP and the rules. What about the old growth? Will old growth stands on the more productive sites be targeted first for even-aged harvesting?	34. The department has calculated a sustainable yield based on meeting but not exceeding all applicable laws and regulations. The model optimized for PNV. In doing so, it targets those stands that produce the greatest financial return thus meeting the department's legal mandate to generate revenue. Other requirements of the department, such as the SFLMP, are also met through introducing additional constraints, but they do not override the department's mandate of generating revenue. Individual preferences and conclusions regarding landscapes and forests may or may not coincide with the outcome, just as they may or may not coincide with the department's stated objectives and legal mandate. The additional analyses requested are

Or if managed will they be managed on the 30 year rotation leaving only the minimum number of trees to meet the old growth definition? This information needs to be displayed, and if this is the case, an explanation given for how the state will do this and also maintain natural historic conditions.	beyond the scope of this calculation.
35. I believe Anne Hedges and Arlene Montgomery have already commented on the inadequate public involvement process, so I will only say that I share their concerns. With a document with such far-reaching consequences as the sustained yield study, a full 30 day public comment period is the very least DNRC could provide. The modelers and DNRC should respond to all public questions as soon as possible, so additional comments can be written in light of their responses. There should be adequate time for the land board members to understand the model and the public concerns before they must make a decision.	35. DNRC believes the public process has been adjusted in an effort to meet these concerns.
36. There is no accounting of the cost of logging. The state is required to make money on all of their timber sales but DNRC does not keep track of the cost of individual timber sales so they have no idea if timber sales make or lose money. From the little information DNRC provides, it looks like many of their timber sales actually lose money.	36. For purposes of clarification, DNRC does not do the logging associated with its timber sales. These logging costs are born by the sale purchaser and are reflected in the bid prices received. DNRC does, however, incur the costs associated with sale preparation and administration. These costs constitute the bulk of our timber management program expenses. These costs are included in the model and are explicitly identified in the Sustained Yield Study Report. Judge Sherlock in his Order Granting Summary Judgment (#BDV-2003-527) determined that the DNRC did not have an obligation to do individual sale accounting. Furthermore, there is no legal requirement

	that each individual sale make money. However, a review of the yearly Return on Assets Report clearly demonstrates that the forest management program generates a net positive revenue to the trust beneficiaries. The DNRC forest management program has historically returned an average of $1.50 to $2.50 for every dollar spent.
37. DNRC does not take into account cost of logging so they assume that every tree on state lands can be logged economically, even trees growing in the middle of cliffs.	37. The model does not assume every tree on state lands can be logged economically or otherwise. Trees located on sites that are inaccessible are excluded early in the modeling process as part of the "deferred acres." Other forested acres were deferred such as wet areas, areas with low volumes and high development costs, campgrounds, etc.
38. DNRC says that its current growth is 83 MMbf/year. However, the SYS Reports states that the highest sustainable biological potential is 95 MMbf/year. DNRC provides no information to show how it will increase timber growth on State lands by 12 MMbf/year.	38. Growth is a complex function of many factors including current volume, current increment, future increment, management intensity, desired future conditions, and management constraints. Yield is what we predict we can harvest based on growth and standing inventory. Sustainable yield is a function of growth plus removals from standing inventory. The current growth of 83 MMbf/year represents the realized annual growth in period one on State lands given our current management regimes, constraints, mitigations, and staffing levels as reflected under SYC008. The 83 MMbf growth is the period two volume minus the period one volume, both divided by five, plus the annual 53.2 MMbf harvest level. This figure represents a one period (5-year) snapshot from a 35 period (175 years) model. The 83 MMbf growth is what the model predicts during period one given a calculated sustainable yield of 53.2 MMbf given the constraints reflected under SYC008. The 95 MMbf/year represents the highest

	sustainable harvest level that could be expected on State lands if the only restriction was the non-declining yield constraint as shown under BM001. (It should be noted that the 95 MMbf/year level would increase if fertilization, planting genetically improved stock, and other cultural practices were applied.) The two numbers are not comparable since the 83MMbf represents growth during period run under SYC008 whereas the 95 MMbf represents the long-term sustainable yield under BM001. Neither the 83 MMbf growth during period one or the 53.2 MMbf sustainable yield are dependent on the 95 MMbf yield represented under BM001. The 83 MMbf represents growth during period one for SYC008 whereas the 95 MMbf represents the long-term sustainable yield under BM001.
39. DNRC did not take into consideration the effects of possible increased mortality on state lands due to fire, insect & disease.	39. Mortality is captured in the model both directly and indirectly. The model uses mortality functions which account for normal, endemic levels of mortality by "killing" trees during every period (five years). The volume and growth associated with these dead trees is removed during that period and is not carried forward to future periods. While endemic losses are modeled through built-in mortality functions, catastrophic mortality (i.e. – fire, disease or insect outbreaks) is not explicitly modeled, but it is generally captured through salvage operations. This allows the substitution of dead timber for green live timber. Therefore, the volume is not lost and the salvaged stands can be regenerated and restored to a productive condition. Major increases in mortality caused by fires and insect and disease are also reflected as the SLI inventory is updated between each sustained yield study. This updated SLI

	information will be used to calculate the next sustained harvest level in 10 years, or sooner if warranted. It would take a considerable event to affect the current sustainable harvest level. If a major catastrophe occurred, then another study could be done as directed by the Land Board. The approach taken by DNRC accounts for mortality in a periodic real-time manner by accounting for endemic levels of mortality through built-in mortality functions, substituting dead volume for green volume, and continual updating of the SLI in between conducting the sustainable yield calculations every 10 years or sooner. Mortality is also reduced by maintaining healthy forests through good management. The other approach would be to use a model, such as the SIMPPLLE Model, to predict and model disturbance regimes and their associated impact on vegetation patterns. In a recent article in the Western Journal of Applied Forestry (WJAF 19(2) 2004), the author clearly states: "*the emphasis [of this model] is on behavioral validity, not on numerical precision*." The problem with this predictive approach is trying to anticipate major events such as fire and other disturbances as "inevitable" prior to such events occurring. The SIMPPLLE Model only suggests potentials or probabilities of an event occurring – not on predicting "inevitabilities". This may have an unwarranted and predetermined effect on harvest levels which may actually exacerbate the fire, insect and disease mortality problems. Artificially lowering the harvest level due to uncertain "predictive" events would have negative results to the forests and to the trust beneficiaries by predisposing many stands to increased levels of mortality.

	The current adaptive approach taken by DNRC adequately accounts for mortality using updated real-time data with periodic adjustments to harvest levels rather than a predictive disturbance approach with its own level of uncertainty.
40. DNRC should use a USFS model called SIMPPLLE to calculate the sustained yield.	40. The SIMPPLLE model is not appropriate for calculating DNRC's sustainable yield. DNRC reviewed several models before conducting the Sustained Yield Study. This spatial model (SIMPPLLE) is designed as a decision support system to simulate disturbance regimes and vegetation patterns at the landscape level. In a recent article in the Western Journal of Applied Forestry (WJAF 19(2) 2004), the author clearly states that "*the emphasis [of this model] is on behavioral validity, not on numerical precision*". The recent Sustained Yield Study by the DNRC used an appropriate model to calculate a sustainable harvest level based on several factors and management constraints. Disturbance factors such as fire are captured in the model both directly and indirectly. The model uses mortality functions which account for normal, endemic levels of mortality. In addition, any major increases in mortality caused by fires and insect and disease are reflected in the updated inventory which is used to calculate the next sustained yield level. This calculation is done every 10 years or sooner if warranted.
41. How do the riparian buffers used in the model compare to the recommendations made by FWP, DNRC rules and federal guideline for T&E Species?	41. FWP does not typically provide DNRC (or to our knowledge other landowners) with recommendation regarding riparian buffers. The riparian buffers utilized in the SYS are consistent with those required under the DNRC Forest Management ARM and the Montana SMZ Law and Rules. Federal guidelines were not utilized in the DNRC SYS.
42. It appears that the model ignored the	42. The buffer widths utilized in the SYS

wider SMZ widths in the ARM for site with high erosion risk?	are consistent with the SMZ widths contain in the Forest Management ARMs as they apply to harvest prescriptions and retention tree requirements. The extended SMZ widths based on high erosion risks contained in the ARMS are only applicable to road construction and other ground disturbing activities such as ground based skidding and partial suspension cable yarding systems. Under the ARMs silvicultural prescriptions are not affected by the SMZ widths extended solely for purposes of high erosion risk.
43. What other rules and laws did the model completely ignore?	43. All applicable rules and laws regulating DNRC timber harvest were incorporated into the SYS.
44. As Land Board Members you are charged with management of School Trust Lands for the "benefit of the Trust". A question you should be asking yourself, is managing for a revenue return on 64% of the acres available and 42% of the asset value returning the proper amount to the Trust? Is this good asset management? As an owner of this land I would say "No".	44. DNRC believes the harvest level recommended by the Sustained Yield Calculation does return the proper amount to the Trust Beneficiaries. The model was set up to reflect the impacts of the policies and laws influencing DNRC's forestland management activities. The model utilized the best available forest inventory information. The forest inventory data included information regarding whether or not the forested polygon could be managed for timber outputs. The linear programming model parameters included constraints regarding levels of management intensity based on forest inventory data, the State Forest Land Management Plan and relevant laws and policy.
45. On Page 13 of the report there are productivity classes shown. From my experience in Western Montana the values being used are very conservative. On some of our better sites we are experiencing 2.5 to 3.5 times the productivity shown. These are key figures in computing the biological sustained yield. Is using these figures benefiting the Trust?	45. The productivity classes shown in the report reflect average productivity levels for the forested acres in that class as estimated through the use of habitat types. There are forested acres with productivity ratings above and below each average productivity number displayed in the table. More productivity classes could have been utilized in the modeling effort but it was determined to be unnecessary because the amount of acreage in the classes above and

	below the three site classes used in the model was relatively minor. The productivity classes shown were assigned to the site index values shown to drive the model's growth predictions.
46. On Page 30 there is "Management Advice" given. There are two statements which concern me. First, it is stated that "even-aged management is more productive and more profitable". Given current environmental constraints I do not believe this is a correct statement. Intensive management that controls stocking levels on a regular basis in uneven-aged stands will be more productive and return more revenue.	46. See response to comment number 12.
47. The second statement that "more inventory is available than needed to meet sustained probable harvest levels" is worrisome. Is the harvest level being set lower to protect the ecosystem, wildlife, etc.? Is this wise management of the Trust assets? Are you following the Trust mandate?	47. See response to comment number 44. An unpublished model run demonstrated that the DNRC could harvest about 58 MMbf/year for approximately 65 years without ever dropping below a sustainable harvest level of 53.2 MMbf/year. That model run depleted standing inventory to the point it was sufficient to maintain the 53.2 MMbf harvest level, only. The complexities of a non-declining even flow result in carrying inventory in excess of needs.
48. Under the proposed sustained harvest level I am concerned about the inventory shown on un-managed acres. Because the mortality increases with age and there is no recovery of this mortality, it is highly unlikely that the inventory on the 237,384 acres will continue to increase. How does the Trust benefit from this loss of revenue?	48. DNRC agrees that in the long-run, the inexorable rise in unmanaged inventory would be unlikely given natural disturbance levels. Most of the 237,384 acres are un-managed because they are considered to be inoperable or unmanageable for a variety of reasons. Therefore the is very little loss to Trust revenue.
49. During development of the sustained yield harvest the SPS growth model was used to show growth and mortality. This model has the capability to show the growth and mortality as separate figures. I would encourage these be included in the final report. These will be important figures in the future to judge performance	49. DNRC will include representative samples of some of the yield tables used by the model in the final report. SPS predicts mortality but does not accumulate or sum the mortality volume throughout the growth and yield projection. This limitation of the SPS model prohibits showing mortality totals for any period of

of land management activities.	the model projection.
50. It is disappointing that the study did not recommend other ways to improve growth and recover mortality so the overall return to the Trust could be improved. One example of ways to improve growth is by investment in fertilization of certain stands.	50. DNRC is a member of the Intermountain Forest Tree Nutrition Cooperative and is keenly aware of the potential benefits of late-rotation fertilization. We recognize that on average fertilization benefits growth, but that there are some sites that respond very favorably while other sites show negative responses. Currently, broadcast fertilization of mature stands is not part of DNRC's silvicultural practices, and so was not modeled. However, we frequently apply small amounts of fertilizer when planting for an added boost to juvenile performance. If fertilization becomes part of DNRC's silvicultural practices it will be included in future sustained yield calculations.